DOCUMENT RESUME

ED 290 448 IR 012 996

AUTHOR Jones, Preston K.
TITLE A Mini-Curriculum for Robotics Education.
PUB DATE 87
NOTE 45p.; Ed.D. Practicum, Nova University.
PUB TYPE Dissertations/Theses - Practicum Papers (043) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Artificial Intelligence; Computer Graphics; Computer Science Education; *Instructional Design; *Instructional Development; Intermediate Grades; Junior High Schools; *Multimedia Instruction; *Robotics; Summative Evaluation

ABSTRACT

This practicum report documents the development of a four-lesson multimedia program for robotics instruction for fourth and seventh grade students. The commercial film "Robot Revolution" and the videocassette tape "Robotics" were used, along with two author-developed slide/audiotape presentations and 14 overhead transparency foils. Two robots, Hero I and Robie, Sr., and 16 Apple IIe microcomputers with turtle graphics were also used. Developmental testing occurred using a group of 41 students who ranged in grade level from fourth through eighth and in ability from above average to those with specific learning disabilities. A summative evaluation indicates that the program is high in quality, leads to positive learning experiences, and is interesting. A 10-item bibliography is provided and 12 appendices provide additional information on the evaluations, the objectives of the course, and lesson plans. (EW)

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A Mini-Curriculum for Robotics Education

by

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NOVA UNIVERSITY

A Mini-Curriculum for Robotics Education

by

Preston K. Jones (Jonesp)

Cohort 4

A Practicum (II) Report Presented to the
Ed.D. Program in Computer Education
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Education.

NOVA UNIVERSITY

1987

TABLE OF CONTENTS

	Page
TABLE OF CONTENTS.	ii
LIST OF TABLES	iv
ABSTRACT	v
Chapter	
1. INTRODUCTION	6
Description of the Community. . . .	6
Author's Work Setting and Role. . .	6
2. STUDY OF THE PROBLEM	8
Problem Description	8
Problem Documentation	8
Causative Analysis.	9
The Related Literature.	9
3. ANTICIPATED OUTCOMES AND EVALUATION INSTRUMENTS.	11
Statement of General Goals.	11
Evaluation Instruments.	11
Behavioral Expectations	12
4. SOLUTION STRATEGIES	14
Discussion and Evaluation of Solutions.	14
Description of Selected Solutions .	14
Report of Action Taken.	14
5. RESULTS, IMPLICATIONS, & RECOMMENDATIONS	18
Results	18
Implications.	19
Recommendations	19
Dissemination	20
BIBLIOGRAPHY	21

Appendices Page

A. COMPUTER COMMITTEE MEETING NOTES 22

B. TEACHER EVALUATION--FORMATIVE 23

C. STUDENT EVALUATION--FORMATIVE 25

D. TEACHER EVALUATION--SUMMATIVE 27

E. STUDENT EVALUATION--SUMMATIVE 28

F. ADVISORY COMMITTEE EVALUATION 29

G. GENERAL OBJECTIVES 31

H. SCOPE & SEQUENCE 32

I. SPECIFIC LESSON OBJECTIVES 33

J. LESSON PLANS 35

K. STUDENT RESPONSES TO QUESTIONNAIRE . . . 41

L. TEACHER AND STEERING COMMITTEE RESPONSES TO QUESTIONNAIRE 43

LIST OF TABLES

Table		Page
1.	Mean of Student Responses to Evaluation Questions	18
2.	Mean of Teacher Responses to Evaluation Questions	18
3.	Mean of Computer Committee Responses to Evaluation Questions	19
4.	Scope and Sequence of Skills	32
5.	Student Responses to Questionnaire Items .	41
6.	Teacher Responses to Questionnaire Items .	43
7.	Advisory Committee Responses to Questionnaire Items	43

ABSTRACT

A Mini-Curriculum for Robotics Education.
Jones, Preston K. 1987: A Practicum Report, Nova University. Ed.D. Program in Computer Education.

Descriptors: Curriculum/Curriculum Design/Curriculum Development/Curriculum Evaluation/Computer Science/Artificial Intelligence/Automation/Robotics.

This project addressed the lack of curriculum leading to adequate instruction in robotics for upper elementary and middle school students. Discussion of the problem with members of the Computer Education Steering Committee and study of the literature revealed the need for such a program. Examination of curriculum guides in the author's School District demonstrated that no such course of study existed. The goal of the project was to develop and test a robotics program for fourth and seventh grade students.

In cooperation with the Committee and other interested educators, the author developed a four lesson, multimedia program for robotics instruction at these grade levels. The commercial film "Robot Revolution" and the video cassette tape "Robotics" were used, along with two author developed slide/audiotape presentations and fourteen overhead transparency foils. Two robots (Hero I and Roble, Sr.) and sixteen Apple IIe computers, using turtle graphics, were also employed.

Developmental testing occurred using a group of forty-one students ranging in grade level from fourth through eighth and ability ranging from above average to those with specific learning disabilities. Additionally, three teachers participated in this phase of development. Hence, several changes were made in pace and mode of presentation. Summative evaluation involved sixty-four students, seven teachers, and eight members of the Computer Education Steering Committee. Analysis of their assessment indicates the program (a) is high in quality, (b) leads to positive learning experiences, and (c) is interesting. Because of these efforts, the program will be included in the District's computer literacy curriculum and implemented beginning January, 1988.

Chapter 1

INTRODUCTION

Description of the Community

This practicum was implemented in a School District of 24,114 students and 2,857 staff. There are 33 schools in the District. Twenty-three are elementary (K-5), five middle (6-8), four high (9-12), and one a vocational school. All socio-economic, racial, and ethnic backgrounds are represented in the student body.

The District has a strong commitment to computer education, evidenced by ownership of more than 1300 instructional computers and 18,600 software packages. In elementary and middle schools, equipment and software are used primarily for computer assisted instruction (CAI) and computer literacy. Programming and computer applications are added at the high school level. A complete curriculum exists for computer education at grades K-8. Robotics was not part of the curriculum at any level.

Author's Work Setting and Role

The writer is Coordinator of Instructional Computing for the District. Duties include development of new curricula and modification of existing curricular programs to ensure student awareness of recent technological advances.

Close contact is maintained with the 14 member Computer Education Steering Committee. The group, composed of five teachers, three administrators, one community college person, and one lay person, sits as an advisory board in matters relating to computer education, including curriculum.

Chapter 2

STUDY OF THE PROBLEM

Problem Description

The use of robots in industry, hazardous duty environments, and foreign environments is rapidly proliferating. It is essential that students have an opportunity to become familiar with the use of these tools. Prior to implementation of the practicum, no District program existed for this purpose.

Problem Documentation

The Computer Education Steering Committee discussed the problem at a meeting (Appendix A:22) and concluded: (1) such a program was needed to help students live in the technological society of today and tomorrow (2) assimilation of such a program into the existing curriculum must be completed with a minimum of disruption, and (3) added burden and responsibility must not be placed on the classroom teacher.

Causative Analysis

The reason a robotics program was not included in the curriculum of the District prior to completion of this practicum is the newness of the technology. Until recently student knowledge of robots was considered unimportant. Such is no longer the case as evidenced by the position of the Steering Committee (see previous section).

The Related Literature

Literature demonstrated a need for the program. Cohen and Meyer (1984, P. 88) state when speaking of robotics, "revolutions and evolutions in technology create new training, updating and retraining needs. These needs prevail among people already in the work force, as well as students who will soon be seeking jobs." Blaesi and Maness (1984, P. 102) add,

> In the elementary classrooms, students are discussing the impact and applications of robots . . . junior high classrooms are excellent places for exploring robots--the machines and their uses.

As James Rehg (1986) explains, the

> manufacturing process will change more by the year 2000 than it has since the turn of the century. Massive retraining in the use of tools will be necessary. One such tool is the robot.

Regarding the question, what needs to be taught in a robotics curriculum, McConnell (1984, P. 9) explains, "There are only three things we can really teach about robots, how to build'em, use'em, and fix'm." Asfahl (1984, P. 103) concurs, "the field of robotics has three major categories: design, operations, and maintenance." Students need not know how to build'em, or fix'em, but must know how they are, and can be used.

Chapter 3

ANTICIPATED OUTCOMES AND EVALUATION INSTRUMENTS

Statement of General Goals

The goal of this practicum was to develop a program fostering student understanding of robots, their uses, and present and future impact on society. The outcome was a program of instruction that accomplishes this goal.

Evaluation Instruments

Success was determined via the following procedures:

1. Evaluation by teachers during field testing (Appendix B:23).
2. Evaluation by students during field testing (Appendix C:25).
3. Evaluation of the completed project by teachers (Appendix D:27).
4. Evaluation of the completed project by students (Appendix E:28).
5. Evaluation of the completed project by members of the Computer Education Steering Committee (Appendix F:29).

Behavioral Expectations

Evaluative procedures one and two were formative and designed to help improve the instructional program during development. Three teachers and forty-one students participated in this developmental and evaluative stage.

Procedures three, four, and five were summative. Seven teachers, sixty-four students, and eight members of the Computer Education Steering Committee participated in the final program and completed summative questionnaires. Responses to these questionnaires were used to evaluate program effectiveness. The following procedures were employed for that purpose.

1. Questions were assigned a point value--five for the most favorable response through one for the least favorable.
2. The mean of all responses to the individual questions was calculated for each group. NOTE: Only the first three questions of the questionnaire in Appendix F:29 were used for the calculations. The remainder assisted in determining the extent that the program should be used in the existing curriculum.

3. A mean of 3.5 or greater was the standard established to indicate success.

All questionnaires were administered and tallied by the author.

Chapter 4

SOLUTION STRATEGIES

Discussion and Evaluation of Solutions

As explained, and supported by the literature in chapter two, the problem was a lack of curriculum leading to robotics instruction in the District.

Description of Selected Solutions

After considering the need for such a program and the recommendations of the Computer Education Steering Committee, it was determined that the best solution was to develop a mini-curriculum for robotics instruction. Further, it was deemed that the program should be developed in a four lesson format, two at fourth grade, and two at seventh.

Report of Action Taken

The curriculum was developed according to the following schedule.

1. General objectives (Appendix G: 31), scope and sequence of the general objectives (Appendix H 32), and specific lesson objectives (Appendix I: 33) were developed in a three week period.

2. Materials, particularly audiovisuals, were gathered and evaluated. This activity consumed approximately five weeks. It was found that few A-V materials exist in the field and, of these, just two were deemed suitable for the program: a video cassette recording (VCR) entitled "Robotics" from Educational Activities Video, Inc. and the film "Robot Revolution" supplied by Florida Power and Light Company. A Hero I robot from Heathkit and a Roble, Sr. robot from Tandy Corporation also were deemed necessary for program success.
3. Owing to the dearth of existing materials, it was necessary to develop others "in-house." These included two (9 minute) slide/audiotape presentations explaining the categories of robots (toy, humanoid, and working) and the kinds of working robots (industrial, hazardous duty, and foreign environment). Also, fourteen permanent overhead projector transparencies were developed, using computer graphics, to help explain various details of the subject. Five weeks were required to complete these tasks.

4. Detailed plans of the four lessons were developed in two weeks (Appendix J:35).
5. Three groups of students (41), ranging from those of above average intellectual ability to those with specific learning disabilities, participated in the field test during one week in June, 1987. Upon completion, the students were asked to evaluate the program using the appropriate instrument (Appendix C: 25). Participating teachers (3) were also asked to evaluate the program (Appendix B: 23).
6. Based on the evaluations, three modifications were affected.
    a. Lecture/discussion time was decreased.
    b. Hands-on (both robot and computer) time was increased.
    c. The pace of the slide presentations was slowed.
7. The final presentation and evaluation of the program was offered to classes of fourth and seventh graders over a period of two weeks. All lessons were presented to both groups, although the program was designed for two lessons at fourth grade and two at seventh. It was felt that fourth graders could not evaluate the program properly unless they were exposed to

the entire presentation, and it would be impossible for seventh graders to evaluate effectively if they began at lesson number three. Participating students assessed the program using the appropriate instrument (Appendix E: 28). Teachers also evaluated the program (Appendix D: 27).

8. Members of the District Computer Education Steering Committee were asked to attend one of the two presentations. Because of other commitments and a reduction in membership resulting from attrition, only eight could participate and evaluate the program (Appendix F: 29).

Chapter 5

RESULTS, IMPLICATIONS, AND RECOMMENDATIONS

Results

The following tables summarize the responses of the three evaluating groups to the questionnaire items. Remember that calculations were based on the 5--1 rating scale described on page twelve. See appendices K:41 and L:43 for a detailed list of the ratings upon which the summary tables are based.

Table 1

Mean of Student Responses
to Evaluation Questions

Overall Rating	Amount of Learning	Interest Level
4.61	4.28	4.47

Table 2

Mean of Teacher Responses
to Evaluation Questions

Overall Rating	Amount of Learning	Interest Level
5.00	4.86	4.86

Table 3

Mean of Computer Committee Responses
to Evaluation Questions

Overall Rating	Amount of Learning	Interest Level
4.88	4.50	4.62

Implications

Using the 3.5 or greater criterion explained on page twelve, clearly the program was a success. Study of the preceding tables reveals the lowest rating as 4.28, the highest 5.00. The composite average is 4.68. Additionally, all participating members of the Computer Education Steering Committee found the program worthy of inclusion in the District's existing curriculum. The majority (5) indicated that the program should be offered on an elective basis.

Recommendations

Based upon such favorable results, the author and The Steering Committee recommended that the curriculum be included with the District's computer literacy offerings. The Director of Curriculum and Staff Development agreed. In January 1988, implementation will take place.

Meanwhile, inservice training will be provided to those teachers and computer contacts who want to participate in the program. All schools represented at the training sessions will receive a complete set of overhead transparencies, slides, audiotapes, handouts, and lesson plans for their media centers or computer laboratories. The film, VCR tape, and robots will be available from the Coordinator of Instructional Computing on a check-out basis.

Dissemination

The information and program presented in this report initially will be disseminated in two ways. First, a presentation at the 1988 Florida Instructional Computing Conference is planned. Second, a journal article describing the program is planned for submission to Electronic Learning, The Electronic Classroom, and Classroom Computer Learning. Via these efforts, it will be possible to share the information and materials with interested educators in Florida and throughout the nation.

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Appendix A

EXCERPT OF NOTES FROM THE COMPUTER EDUCATION
STEERING COMMITTEE MEETING
DECEMBER 3, 1986

Members Present:
- Barbara
- Chris
- Ralph
- Nancy
- Suzette
- Diane
- Deanna
- Rebecca
- Walt
- Larry
- Dalene
- Tom
- David
- Preston

Members Absent:
- Cherrie
- Don
- Tom
- Jan

Preston brought up the importance of robotics in today's society. He asked whether instruction in this area should be included as part of the District's computer curriculum?

Ralph led the lively discussion that followed. Group consensus is that students should be aware of robotics.

Tom commented that he favors the inclusion of robotics in the District's program of instruction, however the burden must not fall on the classroom teacher. They already are overwhelmed. He also pointed out that because of the already crowded curriculum, this program should consume as little time as possible and still be effective. The group agrees with Tom's position.

Preston closed the discussion, stating that he would study the matter and report at the next meeting.

Appendix B

TEACHER EVALUATION--FORMATIVE

The robotics instruction program in which you and your students participated is developmental. To assist in making the program better, please complete the following questionnaire.

THANK YOU

---

1. Assess the overall quality of the program.

___ Excellent
___ Good
___ Fair
___ Poor
___ Very Poor

2. How effective is the program in terms of student learning?

___ Highly Effective
___ Effective
___ Somewhat Effective
___ Little Effect
___ No Effect

3. List the aspects of the program you thought were particularly effective.

a._____

b._____

c._____

d._____

e._____

f._____

4. List the aspects of the program you thought were particularly ineffective.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

5. Provide any general comments and suggestions to improve the program.

_____

_____

_____

_____

_____

_____

_____

Appendix C

STUDENT EVALUATION--FORMATIVE

The program you have just seen is new. Please help us make it better for all students in your school by answering the following questions.

THANK YOU

---

1. Was the program interesting?

___ Yes ___ No

2. How much do you think you learned from the program?

___ A Lot
___ A Little
___ Not Very Much
___ Nothing

3. List the parts of the program that you think were good.

a._____

b._____

c._____

d._____

4. List the parts of the program that you think were not good.

a._____

b._____

c._____

d._____

5. List any ideas you have to make the program better.

Appendix D

TEACHER EVALUATION--SUMMATIVE

The program that you have just seen was developed during the past four months. To help assess its value to the District's computer education program, please complete the following questionnaire.

THANK YOU

---

1. Assess the overall quality of the program.

___ Excellent
___ Good
___ Fair
___ Poor
___ Very Poor

2. How effective is the program in terms of student learning?

___ Highly Effective
___ Effective
___ Somewhat Effective
___ Little Effect
___ No Effect

3. How much student interest in robotics do you think the program generated?

___ A Great Deal
___ A Substantial Amount
___ A Moderate Amount
___ Not Very Much
___ None

Appendix E

STUDENT EVALUATION--SUMMATIVE

The program you have just seen is new. Please help us make it better for all students in your school by answering the following questions.

THANK YOU

---

1. How would you rate the program you just saw?

___ Excellent
___ Good
___ Fair
___ Poor
___ Very Poor

2. How much do you think you learned from the program?

___ A Great Deal
___ Quite a Lot
___ An Average Amount
___ Not Very Much
___ Nothing

3. How interesting was the program?

___ Very Interesting
___ Quite Interesting
___ Somewhat Interesting
___ Not Very Interesting
___ Very Boring

Appendix F

ADVISORY COMMITTEE EVALUATION

The program you have just seen was developed during the past four months. To help assess its value to the District's computer education curriculum, please complete the following questionnaire.

THANK YOU

---

1. Assess the overall quality of the program.

___ Excellent
___ Good
___ Fair
___ Poor
___ Very Poor

2. How effective do you think the program would be in terms of student learning?

___ Highly Effective
___ Effective
___ Somewhat Effective
___ Little Effect
___ No Effect

3. How much student interest in robotics do you think the program would generate?

___ A Great Deal
___ A Substantial Amount
___ A Moderate Amount
___ Very Little
___ None

4. Do you recommend incorporating this mini-curriculum into the District's existing curriculum?

___ Yes ___ No

5. If you answered "yes" to question #4, do you think it should be required in all schools or offered as an elective?

___ Required
___ Elective

6. If you answered "no" to question #4, do you think this program should be retained as a separate curriculum or dropped.

___ Retained
___ Dropped

7. Please make any comments you think appropriate regarding this mini-curriculum.

_____

_____

_____

_____

_____

_____

_____

_____

_____

Appendix G

GENERAL OBJECTIVES

1. The student will understand that a robot is constructed of chips, circuit boards, motors, sensors, etc.

2. The student will understand that a robot must be programmed for every action.

3. The student will understand the differences between humanoids as portrayed by mass media and actual working robots.

4. The student will understand the difference between robotic toys, such as Roble, Sr. and Hero, and working robots.

5. The student will be aware of the present use of robots in an industrial (manufacturing) environment.

6. The student will understand the advantages and disadvantages of using robots in the industrial work place.

7. The student will be aware of the present uses of robots in hazardous occupations.

8. The student will understand the advantages and disadvantages of using robots in hazardous occupations.

9. The student will be aware of the present uses of robots in foreign environments.

10. The student will understand the advantages and disadvantages of using robots in foreign environments.

11. The student will understand the rudiments of robot programming.

12. The student will have entry level experience in programming robots.

Appendix H

Table 4

Scope and Sequence

Objective Number*	Fourth Grade Lesson #1	Fourth Grade Lesson #2	Seventh Gr Lesson #1	Seventh Gr Lesson #2
1	I	R		
2	I	R		
3	I	R		
4	I	R		
5		I	R	
6			I	
7		I	R	
8			I	
9		I	R	
10			I	
11				I
12				I

I = Introduce
R = Reinforce

* Refers to the objectives listed on page thirty.

Appendix I

SPECIFIC LESSON OBJECTIVES

Lesson 1

1. Eighty percent of the students will be able to successfully identify a chip, a circuit board, an input device, a motor, and a sensor with at least 75% accuracy when each part is displayed in context with a robot.

2. Eighty percent of the students will be able to select the correct definition of a robotics program as a series of instructions that bring about a particular action.

3. Seventy-five percent of the students will be able to explain why a fully functional Hero I robot does not respond when provided with voice commands.

4. When presented with ten pictures of actual working robots, humanoids, and toy robots, eighty percent of the students will be able to correctly identify seventy percent of the pictured types.

Lesson 2

1. Given a list of nine possible applications for robots, 75% of the students will be able to identify at least two as industrial uses.
2. Given a list of nine possible applications for robots, 75% of the students will be able to identify at least two as uses in hazardous environments.
3. Given a list of nine possible applications for robots, 75% of the students will be able to identify at least two as uses in foreign environments.

Lesson 3

1. Given a combined list of 6 advantages and disadvantages of using robots in industry, 80% of the students will be able to separate the elements of the list into the two categories with no more than two errors.
2. Given a combined list of 4 advantages and disadvantages of using robots in hazardous occupations, 80% of the students will be able to

separate the elements of the list into the two categories with no more than one error.

3. Given a combined list of 4 advantages and disadvantages of using robots in foreign environments, 80% of the students will be able to separate the elements of the list into the two categories with no more than one error.

Lesson 4

1. All students will program a simulated robot using a computer.
2. Using the direct mode, all students will command a Hero I and a Roble Sr. robot.

Appendix J

LESSON PLANS:

Lesson 1

Objectives:

1. Eighty percent of the students will be able to successfully identify a chip, a circuit board, an input device, and a motor, with at least 75% accuracy when each part is displayed in context with a robot.

2. Eighty percent of the students will be able to select the correct definition of a robotics program as a series of instructions that bring about a particular action.

3. Seventy-five percent of the students will be able to explain why a fully functional Hero I robot does not respond when provided voice commands.

4. When presented with five pictures of actual working robots, humanoid robots, and toy robots eighty percent of the students will be able to correctly identify eighty percent of the pictured types.

Procedures:

1. Present "Hero" doing an introductory program. Make maximum use of this routine as an attention getter.

2. Instruct the students to gather around Hero as closely as possible. Remove "Hero's" covering and point out:
   a. the chips--Pass around the chips provided for student hands-on. Show the students the simple circuit board provided. Have them close their eyes and imagine thousands of little wires and switches sandwiched between two layers of black plastic. While not totally accurate, this mental image will give them the rudimentary concept of a chip.
   b. a circuit board--links a number of chips into a larger circuit. Allow the students to handle the circuit boards supplied.
   c. input devices--Show the students Hero's keyboard and teaching pendant.
   d. the motors--demonstrate forward/reverse, left/right using the immediate input mode.

3. Show part one of the video tape "Basic Robotics."

4. Ask students what they think makes a robot perform its movements. Allow them to do things like talk to it, or push it etc.
   a. Using the programming mode, type the short program provided.
   b. Run the program.
   c. Show the program on the overhead projector. Discuss the function of each step.
   d. Present the definition of a program on the overhead projector. Instruct the students to write it and repeat same orally.

5. Briefly discuss the differences between toy robots, working robots, and humanoids.
   a. Deliver the slide and audio-tape presentation showing the differences between these categories of robots.

Evaluation:

1. Your teacher will point to five (5) parts on "Hero." On the line to the left of the parts listed below, place the number 1 beside the first part pointed to on "Hero." Place a 2 next to the second part. Place a 3 next to the third, etc.

   Chip _____
   Circuit Board _____
   Input Device _____
   Motor _____

2. Your teacher will display five pictures, one at a time. On the lines below, next to the picture number write;
   R--if the picture is a working robot.
   T--if the picture is a toy robot.
   H--if the picture is a humanoid robot.

   1. _____
   2. _____
   3. _____
   4. _____
   5. _____

3. "Hero" does not respond when you talk to it because:(place an "X" next to your choice)
   _____ 1. It needs more voltage.
   _____ 2. It only understands a program.
   _____ 3. It is missing a chip.

4. The correct definition of a robot program is: (place an "X" next to your choice)

_____ 1. a series of instructions that bring about a particular action.
_____ 2. a whole bunch of things that tell about a robot.
_____ 3. everything that a programmer needs to know.

Lesson 2

Objectives:

1. Given a list of nine possible applications for robots, 75% of the students will be able to identify at least two as industrial uses.
2. Given a list of nine possible applications for robots, 75% of the students will be able to identify at least two as uses in hazardous environments.
3. Given a list of nine possible applications for robots, 75% of the students will be able to identify at least two as uses in foreign environments.

Procedures:

1. Conduct a class discussion reviewing the four objectives in lesson one.
   a. Parts of the robot--Use "Hero"
   b. Definition of a program--Use the overhead foil from lesson one.
   c. Categories of robots--Use the overhead foil created for review.
2. Introduce the lesson by showing the film "Robot Revolution" (F-1907).
3. To accomplish objective #1:
   a. Using the prepared overhead transparency foil, explain what is meant by an industrial robot.
   b. Ask the students to list how they think industrial robots might be used.
   c. Present the first segment of the slide presentation and audiotape prepared for that purpose.
4. To accomplish objective #2:
   a. Using the prepared overhead transparency foil, discuss what is meant by a hazardous environment and a foreign environment. NOTE: Be sure the students understand the difference.

b. Ask the students what duties they think robots might perform in hazardous environments.
c. Present the second segment of the slide presentation and audiotape prepared for that purpose.

5. To accomplish objective #3:
   a. Quickly review what is meant by a foreign environment.
   b. Ask the students what duties they think robots might perform in foreign environments.
   c. Present the third segment of the slide presentation and audiotape prepared for that purpose.

Evaluation:

Listed below are nine possible uses of robots in different settings. On the line to the left of each application, please write an:
I--if you think the use is for industry.
H--if you think the use is for hazardous environments.
F--if you think the use is for foreign environments.

1. ____ To weld cars on an assembly line.
2. ____ To gather precious metals from the ocean floor.
3. ____ To spray paint refrigerators while they are being made.
4. ____ To repair satellites in outer space.
5. ____ To move uranium in a nuclear power plant.
6. ____ To rescue stranded astronauts.
7. ____ To work with dangerous chemicals.
8. ____ To work inside a building where there are poisonous gases.
9. ____ To move materials from one place to another in a factory.

Lesson 3

Objectives:

1. Given a combined list of 6 advantages and disadvantages of using robots in industry, 80% of the students will be able to separate the elements of the list into the two categories with no more than two errors.

2. Given a combined list of 4 advantages and disadvantages of using robots in hazardous occupations, 80% of the students will be able to separate the elements of the list into the two categories with no more than one error.
3. Given a combined list of 4 advantages and disadvantages of using robots in foreign environments, 80% of the students will be able to separate the elements of the list into the two categories with no more than one error.

Procedures:

1. Introduce the lesson with "Hero" removing an offensive object, such as a loaf of moldy bread from the proximity of the audience.
2. Review the previous lesson very carefully. NOTE: This is a critical element in the lesson. It will have been three years since the student's last exposure to the information.
3. Project part 2 of the videotape "Basic Robotics."
4. To accomplish objective #1:
   a. Discuss the advantages and disadvantages of using robots in industry. Use the overhead foils prepared for this purpose.
   b. Direct the students to list as many advantages and disadvantages of industrial robots as they can remember.
   c. Discuss their listings.
5. To accomplish objectives #2 and #3:
   a. Repeat the same procedure for objective #1, using the overhead foils for the second and third objectives.
6. Introduce the students to EZ Logo. Discuss the handout on commands.
7. Have the students complete the hands-on activity for the lesson.

Evaluation:

1. Listed below are 6 advantages and disadvantages of using robots in industry. On the line to the left of each place an "A" if the statement is an advantage or a "D" if it is a disadvantage.
   ____ Robots take the place of workers.
   ____ Robots do not require a vacation.
   ____ Robots do not require safe working conditions.
   ____ Robots are expensive to build.
   ____ Robots must be programmed.

____ Robots will work 24 hours a day, 7 days a week and never need a break.

2. Listed below are 4 advantages and disadvantages of using robots in hazardous environments. On the line to the left of each place an "A" if the statement is an advantage or a "D" if it is a disadvantage.
   ____ Robots do not need air to breathe.
   ____ Robots are expensive.
   ____ Robots cannot think in an emergency.
   ____ Robots can handle dangerous materials without being affected.

3. Listed below are 4 advantages and disadvantages of using robots in foreign environments. On the line to the left of each place an "A" if the statement is an advantage or a "D" if it is a disadvantage.
   ____ Robots are not affected by high pressure.
   ____ Robots are not affected by low pressure.
   ____ Robots are expensive.
   ____ Robots can easily be replaced.

Lesson 4

Objectives:

1. All students will program a simulated robot using a computer.
2. Using the direct mode, all students will command a Hero I and Roble, Sr. robot.

Procedures:

1. Provide all students with the necessary instructions for running the computer program. Get all students started on the project.
2. In a learning center, allow each student to activate and control "Hero" using the teaching pendant.

Evaluation:

Teacher observation.

Appendix K

Table 5

Student Responses to Questionnaire Items

Stu #	Overall Rating	Amt of Learning	Interest Level
1	5	5	5
2	5	4	4
3	5	4	5
4	5	5	5
5	4	4	3
6	5	5	5
7	5	5	5
8	5	5	4
9	5	5	5
10	5	4	5
11	4	3	5
12	5	5	5
13	5	5	5
14	5	5	5
15	5	4	4
16	5	4	5
17	4	2	2
18	1	1	1
19	4	3	4
20	4	3	4
21	5	4	4
22	5	4	5
23	5	5	5
24	5	5	5
25	5	5	5
26	4	3	4
27	4	3	4
28	5	4	5
29	4	3	3
30	5	2	4
31	4	4	3
32	5	5	5
33	5	5	5
34	5	5	5
35	5	5	5
36	5	5	5
37	4	5	5
38	4	4	3
39	4	4	4
40	5	5	5

Table 5 (Continued)

Student Responses to Questionnaire Items

Stu #	Overall Rating	Amt of Learning	Interest Level
41	4	3	3
42	5	5	5
43	5	5	5
44	5	5	5
45	5	5	5
46	5	5	5
47	4	4	5
48	3	4	4
49	5	5	5
50	5	5	5
51	5	5	5
52	3	3	5
53	5	5	5
54	5	5	4
55	5	5	4
56	5	5	5
57	5	5	5
58	5	5	5
59	5	5	5
60	5	5	5
61	5	5	5
62	5	3	3
63	3	3	5
64	4	3	3
MEAN	4.61	4.28	4.47

Appendix L

Table 6

Teacher Responses to Questionnaire Items

Tch #	Overall Rating	Amt of Learning	Interest Level
1	5	4	4
2	5	5	5
3	5	5	5
4	5	5	5
5	5	5	5
6	5	5	5
7	5	5	5
MEAN	5.00	4.86	4.86

Table 7

Steering Committee Responses to Questionnaire Items

Mem #	Overall Rating	Amt of Learning	Interest Level
1	5	4	4
2	5	5	5
3	5	4	4
4	4	4	4
5	5	5	5
6	5	5	5
7	5	5	5
8	5	4	5
MEAN	4.88	4.50	4.62